GE ColorXpress Administration

EXHIBIT D

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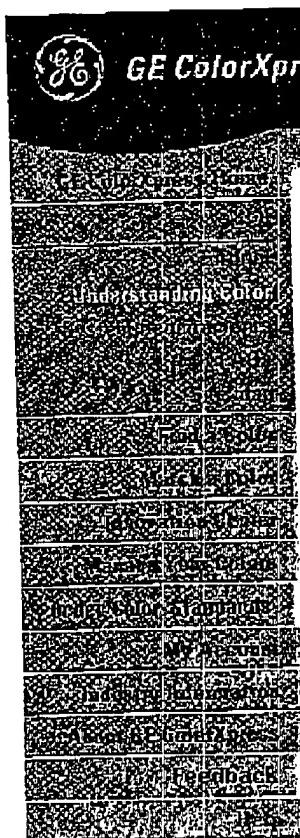
Understanding Color

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Color Difference Measurements

The numeric and graphical color differences between standard and color match are vital to color match acceptance and color control of production material. These Delta values are used to express the mathematical differences between standard and the color match or standard and the production batch.

Delta L (Đ L) Lightness/darkness differences
+ = lighter than, − = darker than

Delta a (Đ a) Red/green difference
+ = color is redder than, − = color is greener than

Delta b (Đ b) Yellow/blue difference
+ = color is yellower than, − = color is bluer than

Delta c (Đ c) Chroma or saturation differences
+ = more chroma, − = less chroma

Delta h (Đ h) Difference in hue expressed as an angular difference

Delta E (Đ E) A single number that expresses total color difference which includes: lightness/darkness, redness/greenness, yellowness/blueness

These Delta values, if properly applied, may be used to specify maximum differences for acceptance or rejection. This should only take place after *visual evaluations* have established *exactly* what is acceptable and not acceptable. The **Delta L, a** and **b** values can be important *tools* to assist in refining colorant formulations to more closely match a standard. This can be done since the +/− numbers show the color trends needed to address unsatisfactory colors.

Delta E is a single number indicating the total or collective color difference between standard and sample. It describes the magnitude of a color difference, but does not indicate in any way in what direction those differences may be. Therefore, a Delta E value by itself has limited utility or value.

The Basics (

Quantify C
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Furthermore, Delta E is not linear throughout color space. A Delta E of 1.0 CIELab would be visible to most observers between neutral beige or grays but may not be visible at all in a highly chromatic blue. Delta E should be specified carefully and only with full knowledge of its limitations.

Delta E is calculated via the Pythagorean Theorem as follows:

$$DE = \sqrt{DL2 + Da2 + Db2}$$
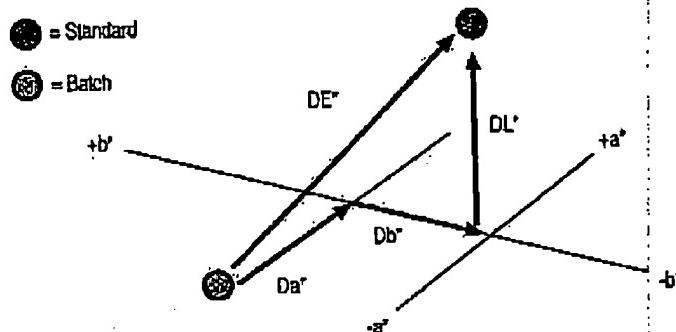
Rectangular Coordinates L*a*b*
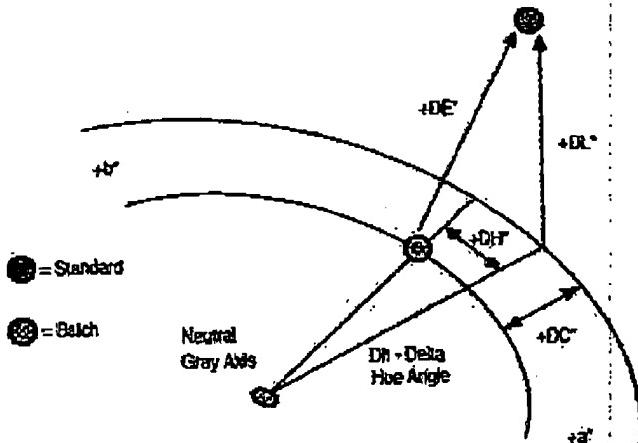
Polar Coordinates L*C*h*

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